

## Quality Assurance Project Plan for Hydraulic Fracturing

### APPROVAL SHEET

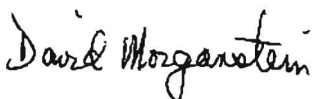
Signatures indicate approval of this Quality Assurance Project Plan and commitment to follow the applicable procedures noted:



David Marker – Westat Work Assignment Manager

7/14/2011


Date



David Morganstein – Westat QA Officer

7/14/2011

Date



Beverly Randolph – EPA Technical Project Officer



Date



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**EPA Contract EP-C-10-023**

**Quality Assurance Project Plan v1.1 for**

**HYDRAULIC FRACTURING**

Prepared for:

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Office of Water  
Engineering and Analysis Division  
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Rockville, MD 20850

July 14, 2011

## Quality Assurance Project Plan for Hydraulic Fracturing

### APPROVAL SHEET

Signatures indicate approval of this Quality Assurance Project Plan and commitment to follow the applicable procedures noted:



7/14/2011

David Marker – Westat Work Assignment Manager

Date



7/14/2011

David Morganstein – Westat QA Officer

Date

Signature is on file, dated

Beverly Randolph – EPA Technical Project Officer

Date

Signature is on file, dated July 15, 2011

Jeanne Briskin – EPA Work Assignment Manager

Date

Signature is on file, dated July 15, 2011

Lora Johnson – EPA/Acting Quality Assurance Manager/Officer of Science Policy

Date

### Distribution (Element A.3)

This Quality Assurance Project Plan (QAPP) will be distributed to staff of the U.S. Environmental Protection Agency and Westat (Table 1). A copy of the document will be provided to all Westat staff involved in the project, including those who join the project after publication of the QAPP.

**Table 1. QAPP distribution**

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EPA does not consider this internal planning document an official Agency dissemination of information under the Agency's Information Quality Guidelines, because it is not being used to formulate or support a regulation or guidance; or to represent a final Agency decision or position. This planning document describes the quality assurance/quality control activities and technical requirements that will be used during the research study. EPA plans to publish the research study results in a draft report, which will be reviewed by the EPA Science Advisory Board. The final research report would be considered the official Agency dissemination. Mention of trade names or commercial products in this planning document does not constitute endorsement or recommendation for use.

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## **1. Introduction**

EPA is preparing to study the potential impacts of hydraulic fracturing on drinking water resources at the request of the U.S. Congress, specifically the Appropriations Conference Committee of the House of Representatives. Policymakers will use the information from this study in any regulatory or policy decisions regarding hydraulic fracturing. ERG assisted EPA in developing a technical questionnaire that was sent to nine companies. EPA received questionnaire responses from all nine companies. Westat will assist EPA in analyzing the nine questionnaire responses to determine how representative these companies are of hydraulic fracturing companies throughout the nation and for major fracturing areas. We will then develop a sampling plan and select a sample of nine oil and gas companies for whom these fracturing companies drilled wells. Westat will also select a set of the wells drilled by the hydraulic fracturing companies for which the oil and gas companies will be asked to provide information.

EPA is collecting information and data regarding the use and composition of hydraulic fracturing fluid being used by the oil and gas industry. Data sources include both secondary data and primary data collected from the technical industry questionnaire. This plan addresses the secondary data sources, as Westat will not be involved in any of the primary data collection.

As directed by EPA, Westat has prepared this detailed Quality Assurance Project Plan (QAPP). It is responsive to all applicable elements specified in EPA Requirements for Quality Assurance Project Plans (1). This QAPP is a project-specific supplement to Westat's Quality Management Plan approved April 17, 1998 and revised December 1, 2009, which was prepared in accordance with EPA Requirements for Quality Management Plans. Westat's QMP details the responsibilities of the Westat's Quality Assurance Officer (QAO) and Project Management Team and describes procedures used to plan, implement, and assess project quality. These procedures, tailored to the needs of the tasked activities, will be used on Westat's work assignment associated with this program.

References are presented in Section 6. Throughout this document, each time a reference is cited, a number corresponding to the Section 6 listing is shown in parentheses.



## **2. Project Management Elements**

This section addresses project management, including project history and objectives, roles and responsibilities, and project goals. In addition, this section presents the mechanisms EPA and ERG will use to ensure that all participants understand the goals and the approach to be used for this project. In its Requirements of Quality Assurance Project Plans (1), EPA identifies the following nine project management elements:

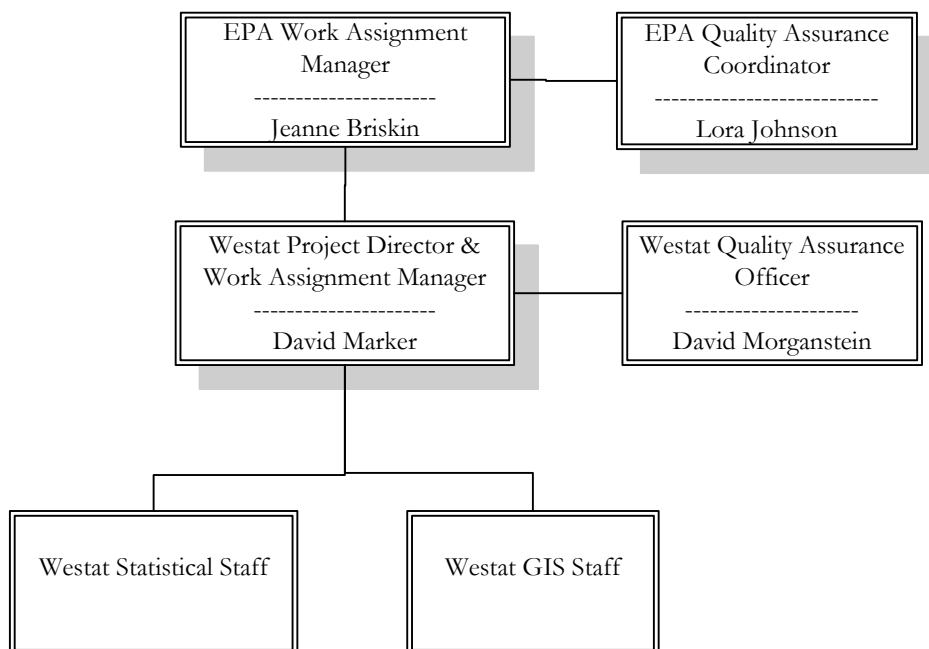
- A.1: Title and Approval Sheet;
- A.2: Table of Contents;
- A.3: Distribution List;
- A.4: Project Organization;
- A.5: Problem Definition/Background;
- A.6: Project/Task Description;
- A.7: Quality Objectives;
- A.8: Special Training/Certification; and
- A.9: Project Documents and Records.

Elements A.1 through A.3 have been provided earlier in this document. The remaining elements are presented below.

### **2.1 Element A.4: Project Organization**

Project organization for Westat's support of this project is depicted in Figure 2-1. The Westat Project Director and WAM will be responsible for management and administrative aspects of the work performed. He will also be responsible for ensuring that the quality of work, schedule, and budget meet the requirements of the EPA hydraulic fracturing study. He will provide technical direction and oversight to Westat staff. He will be the principal contact for the EPA WAM on project issues, deliverables, and schedule. The Westat WAM will also keep the Project QA Officer advised of any quality problems that arise.

The Project QA Officer will be responsible for the development and execution of QA activities throughout the course of the project, including those related to the questionnaire task. The Project QA Officer will also ensure that the Westat WAM is obtaining appropriate technical review of all deliverables.



**Figure 2-1. Project Level QA Organization for Westat’s Support for the Evaluation of Information on Hydraulic Fracturing**

## 2.2 Element A.5: Problem Definition/Background

This section explains the purpose of the hydraulic fracturing study. It also presents a brief background of hydraulic fracturing.

### **2.2.1 Background**

Hydraulic fracturing is a well stimulation process used to maximize the extraction of underground resources – oil, natural gas, and geothermal energy. Hydraulic fracturing involves the pressurized injection of fluids commonly made up of water and chemical additives into a geologic formation. The pressure exceeds the rock strength and the fluid opens or enlarges fractures in the rock. As the formation is fractured, a “propping agent,” such as sand or ceramic beads, is pumped into the fractures to keep them from closing as the pumping pressure is released. The fracturing fluids (water and chemical additives) are then returned to the surface. Natural gas will flow from pores and fractures in the rock into the well for subsequent extraction. Wells used for hydraulic fracturing are drilled vertically, vertically and horizontally, or directionally. Wells may extend to depths greater than 8,000 feet and horizontal sections of a well may extend several thousand of feet away from the production pad on the surface.

Fracturing fluids can be up to 99 percent water. The volume of water needed for hydraulic fracturing varies by site and type of formation. Up to 350,000 gallons of water may be required to fracture one well in a coalbed formation while five million gallons of water may be necessary to fracture one horizontal well in a shale formation. Water used for fracturing fluids is acquired from surface water or groundwater near the well production area.

Wastewaters from the hydraulic fracturing process may be disposed of in several ways. For example, the flowback water following fracturing may be returned underground using a permitted underground injection well, discharged to surface waters after treatment to remove contaminants, or applied to land surfaces. However, not all fracturing fluids injected into the geologic formation during hydraulic fracturing are recovered. Data indicate that between 15 and 80 percent of the volume injected is recovered (2).

Over the past few years, the use of hydraulic fracturing for gas extraction has increased and has expanded over a wider diversity of geographic regions and geologic formations. Public concerns have focused recently on the potential drinking water impacts of the hydraulic fracturing process used during natural gas production from shale and coalbed methane formations. Given this expansion and increasing concerns, EPA announced in March 2010 that it would study the potential adverse impact that hydraulic fracturing may have on drinking water. EPA developed a draft study plan using input from EPA’s Science Advisory Board to focus on drinking water resources (quality and quantity) using a case-study approach.

During the summer of 2010, EPA conducted a series of meetings to receive broad, balanced input on its draft study plan from stakeholders in key regions affected by hydraulic fracturing. EPA collected public comments from these meetings and on its draft study plan through October of 2010. EPA then collected data from nine oil and gas development companies that use hydraulic fracturing. The objectives of the survey were:

- Identify key industry operators;
- Obtain contact information for persons within each company most familiar with hydraulic fracturing operations and for companies that have been contracted for hydraulic fracturing;
- Gain information on the location and services performed for past and future hydraulic fracturing operations;
- Obtain the names and formulations/mixtures of hydraulic fracturing fluids;
- Obtain chemical and proppant constituent information for each formulation/mixture of hydraulic fracturing fluid;
- Define policies, practices, and standard operating procedures for common operations; and
- Identify water specifications for each formulation/mixture.

### **2.2.2 Statement of Key Questions and Project Objectives**

Westat is supporting EPA in its study of the use and potential impacts of hydraulic fracturing on drinking water and public health.

Westat will support EPA in answering the following key questions:

1. How representative are the hydraulic fracturing companies that responded to its 2010 survey?
2. How many wells should be included in the 2011 survey of oil and gas companies?
3. How should the oil and gas companies be selected?
4. How does hydraulic fracturing affect drinking water quality, especially drinking water aquifers and surface water bodies?
5. How does hydraulic fracturing and the associated dewatering affect hydrogeology, such as structural stability and subsidence?
6. What practices are established to control groundwater/drinking water impacts?
7. What methods are being used for chemical analyses of the hydraulic fracturing fluid?
8. How does hydraulic fracturing differ across the country?

Westat will summarize findings in a series of memoranda.

## **2.3 Element A.6: Project/Task Description**

This section provides a management level overview of the work Westat will perform in support of this project. Westat will perform this work at the direction of EPA.

### **2.3.1 Assessment of representativeness**

Westat will evaluate data collected by EPA from 9 hydraulic fracturing companies regarding their practices, and information regarding the hydraulic fracturing and oil and gas industries in order to assess the extent to which the 9 respondents are representative of their industry as a whole. Westat will examine third-party sources (e.g. websites and industry representatives) to gather independent information on the number of wells recently drilled and their approximate locations. We will then compare the distribution of wells from these sampled companies with estimates of the universe of all wells.

### **2.3.2 Statistical sample designs**

Westat will provide statistical support to meet EPA's objective to evaluate the potential impacts of hydraulic fracturing on drinking water resources. EPA plans to request information from oil and gas producers who were the customers of the hydraulic fracturing companies that responded to EPA's 2010 request. EPA's request is expected to include a request for well files for a sample of wells that were reported by the hydraulic fracturing companies. EPA desires that this new request go to no more than 9 oil and gas companies, and that the request provide information as representative as possible of hydraulic fracturing as conducted in the continental United States. Westat will identify, evaluate, and recommend options for choosing 9 oil and gas companies from which EPA could request information in order that the companies are representative of oil and gas operations that use hydraulic fracturing in the continental United States, and to the extent possible, that the data are representative of activities conducted in the major shale plays, coal bed methane, and tight sands production areas of the continental United States. In addition to selecting the 9 oil and gas companies, Westat will propose a sample size, sampling plan, and study design for selecting wells for which those 9 companies must provide information to EPA. This plan will focus on a sample of wells that will result in representative data. EPA desires that the study design be as simple as

possible, and Westat will evaluate the extent to which including stratification to gain representativeness provides improved results.

### **2.3.3 Revised sample weights and guidance**

Westat will provide survey weights and statistical documentation on applying the survey weights. When respondents identify particular circumstances that might affect the survey weights (e.g., eligibility) and statistical analyses, Westat will provide recommendations to EPA in handling the response. After the response deadline and EPA classifies the sample draw into appropriate categories (i.e., respondents, out-of-scope, non-respondent, etc.), Westat will provide draft and revised survey weights that are adjusted for nonresponse and other factors.

### **2.3.4 Population estimates**

Westat will provide statistical estimates of population and subpopulation sizes, characteristics, and variability in response to technical direction that identifies the specific population estimates and types of adjustments such as non-response, undercounts, over-counts, and post-stratification. In addition, Westat will adjust analysis results for missing data resulting from item and survey non-response. With each set of population estimates, Westat will provide documentation about the population definitions, statistical, methodology and the results. Westat will incorporate EPA comments and updated databases into revisions.

### **2.3.5 Survey statistics appendix**

Westat will provide an outline, draft appendix, and final version of the appendix that describe the survey design, outcomes, and methodology for population estimation. Westat will incorporate the EPA WAM comments into revised versions. The final version shall be delivered in a format that can be easily incorporated into one of the main technical documents for the study.

### **2.3.6 Respond to statistical issues**

Upon receipt of written technical direction, Westat will provide statistical review and comments on documents specific to hydraulic fracturing. These documents will be provided to Westat by the EPA WAM. EPA may obtain these studies from sources such as OW, other EPA Offices, EPA Regions, states, other government agencies including OMB, industry reports, and professional journals.

Westat will provide up to three additional statistical analyses, statistical review, and research relevant to hydraulic fracturing as specified in written technical directives.

## **2.4 Element A.7: Quality Objectives and Acceptance Criteria**

This QAPP is intended to ensure that data collected for the evaluation of hydraulic fracturing information are of the quality necessary to support EPA in developing practices to reduce the impact of hydraulic fracturing procedures on water resources. The main sources of data for this task are data collected in the questionnaires, existing EPA studies, web sites, and third-party databases.

All project deliverables will include documentation supporting the work that identifies the sources of data, assumptions made, and calculations used in their development with sufficient detail so that the work can be reproduced by qualified third parties.

### **2.4.1 Assessment of representativeness**

Westat will evaluate data collected by EPA from 9 hydraulic fracturing companies regarding their practices, and information regarding the hydraulic fracturing and oil and gas industries in order to assess the extent to which the 9 respondents are representative of their industry as a whole. Westat will examine third-party sources (e.g. websites and industry representatives) to gather independent information on the number of wells recently drilled and their approximate locations. We will then compare the sampled wells with these estimates of the universe of all wells.

Westat will compare the data from the 9 responses with third-party data that are available on the web or through industry contacts, as described in Table 2.

**Table 2. Representativeness data acceptance criteria**

<b>Acceptance Criterion: Questionnaire Data</b>	<b>Description/Definition</b>	<b>Specification</b>
<b>Timeliness</b>	<b>Are data current?</b>	<b>What time period is covered by the data?</b>
<b>Internal consistency</b>	<b>For an individual data source, do national numbers equal the sum of all subnational areas?</b>	<b>Does it appear that parts of the data are missing or inconsistent?</b>
<b>Completeness</b>	<b>For a given data source, does it cover the entire country? Does it cover some or all shale plays?</b>	<b>There should be documentation of whether or not the reported data cover the entire country or are restricted to specific locations.</b>
<b>Representativeness</b>	<b>Do the questionnaire data represent all shale plays?</b>	<b>Compare compiled questionnaire data to available websites or industry sources.</b>

#### **2.4.2 Statistical sample designs**

EPA plans to request information from oil and gas producers who were the customers of the hydraulic fracturing companies that responded to EPA's 2010 request. EPA's request is expected to include a request for a representative set of files for a sample of wells that were reported by the hydraulic fracturing companies. Westat will identify, evaluate, and recommend options for choosing 9 oil and gas companies from which EPA could request information in order that the companies are representative of oil and gas operations that use hydraulic fracturing in the continental United States, and to the extent possible, that the data are representative of activities conducted in the major shale plays, coal bed methane, and tight sands production areas of the continental United States. Westat will propose a sample size, sampling plan, and study design to achieve this representativeness.

Westat will identify and assess data sources and databases regarding the make-up and structure of the oil and gas producer industry as well as the database provided by EPA based on responses from the 9 hydraulic fracturing companies. These will be used to develop the sample frame for selecting a sample of oil and gas companies. Westat will recommend a sample design and based on comments from EPA it will develop a finalized design. We will then select the sample of oil and gas companies.



**Table 3. Sample design data acceptance criteria**

<b>Acceptance Criterion: Questionnaire Data</b>	<b>Description/Definition</b>	<b>Specification</b>
Timeliness	Are data current?	Do the data all cover the same time period?
Representativeness	Will the sample design yield a representative sample of companies?	Are the sampled companies likely to include wells across all shale plays?
Completeness	For a given data source, does it cover the entire country? Does it cover some or all shale plays?	There should be documentation of whether or not the reported data cover the entire country or are restricted to specific locations.
Comparability	Are the data from the different data sources consistent?	Compare counts of companies and/or wells in different locations.

### **2.4.3 Revised sample weights and guidance**

Westat will provide survey weights and statistical documentation on applying the survey weights. When respondents identify particular circumstances that might affect the survey weights (e.g., eligibility) and statistical analyses, Westat will provide recommendations to EPA in handling the response. Westat will provide draft and revised (based on EPA comments) survey weights that are adjusted for nonresponse and other factors.

**Table 4. Sampling weights data acceptance criteria**

<b>Acceptance Criterion: Questionnaire Data</b>	<b>Description/Definition</b>	<b>Specification</b>
Precision	Can the weights be improved to increase precision?	Examine weight outliers for possible trimming.
Bias	Do the weights yield unbiased estimates?	Is there collapsing or other factors that could lead to biased estimates?
Completeness	What response rate was achieved? Is that likely to introduce any bias?	Document the response rate both at the company and well level.

### **2.4.4 Population estimates**

Westat will provide statistical estimates of population and subpopulation sizes, characteristics, and variability for specific population estimates and types of adjustments such as non-response, undercounts, overcounts, and post-stratification. In addition, Westat will adjust analysis results for missing data resulting from item and survey non-response. With each set of population estimates, Westat will provide documentation about the population definitions, statistical, methodology and the results. Westat will incorporate EPA comments and updated databases into revisions. Copies of computer programs and databases will be provided for final versions, along with corresponding documentation.

**Table 5. Population estimates data acceptance criteria**

<b>Acceptance Criterion: Questionnaire Data</b>	<b>Description/Definition</b>	<b>Specification</b>
Precision	Can the weights be improved to increase precision?	Examine weight outliers for possible trimming.
Bias	Do the weights yield unbiased estimates?	Is there collapsing or other factors that could lead to biased estimates?
Completeness	What response rate was achieved? Is that likely to introduce any bias?	Document the response rate both at the company and well level.
Comparability	Are the data consistent with other available data?	Compare counts of companies and/or wells with other available data sources.

#### **2.4.5 Survey statistics appendix**

Westat will provide an outline, draft appendix, and final version of the appendix that describe the survey design, outcomes, and methodology for population estimation. Westat will incorporate the EPA WAM comments into revised versions. The final version shall be delivered in a format that can be easily incorporated into one of the main technical documents for the study.

**Table 6. Statistical appendix data acceptance criteria**

<b>Acceptance Criterion: Questionnaire Data</b>	<b>Description/Definition</b>	<b>Specification</b>
Completeness	Does the appendix cover all activities conducted by Westat?	Review all previous deliverables for inclusion.
Usability	Is the appendix in the appropriate format(s)?	Discuss with EPA any formatting requirements.

#### **2.4.6 Respond to statistical issues**

Westat will provide statistical review and comments on documents specific to hydraulic fracturing. These documents will be provided to Westat by the EPA WAM. EPA may obtain these studies from sources such as OW, other EPA Offices, EPA Regions, states, other government agencies including OMB, industry reports, and professional journals. Westat will provide a preliminary assessment to EPA to assure we are interpreting the issues consistent with EPA's needs. In-depth review will then be reported in detailed memoranda or reports.

**Table 7. Statistical issues data acceptance criteria**

<b>Acceptance Criterion: Public Comments</b>	<b>Description/Definition</b>	<b>Specification</b>
<b>Accuracy</b>	<b>Are the data in document an accurate reflection of the best information available?</b>	<b>Compare data sources with those used by EPA.</b>
<b>Representativeness</b>	<b>Are the data representative of what they claim to be?</b>	<b>Identify data sources and compare to other available information.</b>
<b>Comparability</b>	<b>Are the data consistent with the goal of EPA's analysis?</b>	<b>Do these data address the same questions as EPA is addressing. Even if not a perfect match, do they provide useful insights?</b>

## **2.5 Element A.8: Special Training/Certification**

During the course of this work assignment, Westat will be accessing and evaluating TSCA CBI data. Westat will, at all times, adhere to CBI procedures when handling confidential information. Westat will manage all reports, documents, and other materials and all draft documents developed under this work assignment in accordance with the procedures set forth in EPA's TSCA CBI Protection Manual dated October 20, 2003 (3). Westat staff requiring access to TSCA CBI for this project will maintain active TSCA CBI clearance. The Westat's Rockville office has an approved TSCA CBI storage area, which allows Westat staff to work on TSCA CBI at that location. All work involving TSCA CBI will be completed at Westat's Rockville MD office.

## **2.6 Element A.9: Documents and Records**

Westat has developed and instituted document control mechanisms for the review, revision, and distribution of QAPPs. Each QAPP has a signed approval form, title page, table of contents, and EPA-approved document control format (shown below) that appears in the upper right-hand corner of each page:

Section No.  
Revision No.  
Date

During the course of the project, any revision to the QAPP will be circulated to all Westat and EPA project staff. Westat will document the circulation of the revised QAPP to project staff with a signature page for the revision.

Westat will follow its Current Best Method for Documentation to track major communications between staff and between Westat and EPA (see the appendix for a summary of the CBM). All memoranda will be tracked in a Memo Log. Modifications or replacements to earlier memos are given revision numbers so it is clear what is being replaced. At the beginning of any revised memo there is a short description of what has changed and what has not.

Because many industries identified their questionnaire data as TSCA CBI, Westat's hydraulic fracturing record database will also be treated as TSCA CBI. The record database will be stored in Westat's TSCA CBI room, on a TSCA CBI computer. Access to the locked TSCA CBI room is limited to those Westat employees with CBI clearance.

Management of project data is specifically described in Element B.10, Data Management, of this QAPP.

### **3. Data Generation and Acquisition**

This section describes data generation and acquisition; however, Westat will not be responsible for generating any data. We will be developing sampling plans and managing data that are returned to EPA. Therefore, this section discusses the following two elements:

- B.1: Sampling Process Design; and,
- B.10: Data Management.

The following elements are not relevant to Westat's support of EPA's hydraulic fracturing study, because Westat will not be supporting field work.

- B.2: Sampling Methods;
- B.3: Sample Handling and Custody;
- B.4: Analytical Methods;
- B.5: Quality Control;
- B.6: Instrument/Equipment Testing, Inspection and Maintenance;
- B.7: Instrument/Equipment Calibration and Frequency; and
- B.8: Inspection/Acceptance of Supplies and Consumables.
- B.9: Nondirect Measurements; and

#### **3.1 Element B.1: Sampling Process Design**

For this survey, Westat will design a sample for selecting 9 oil and gas companies from among those represented among the respondents to the previous sample of 9 hydraulic fracturing companies. We will also select a sample of wells for those oil and gas companies to include in their responses.

In both cases a probability-based design will be used. It may be that in selecting nine oil and gas companies to represent activities across the country will require some to be selected with certainty. The design will reflect oil and gas companies that operate in all of the major shale plays in the country. Our goal is to include companies of different size since it is possible that well

characteristics could be related to company size. For example, larger companies may have more complete records and may use different types of chemicals.

Westat will use standard software (e.g. Excel, SAS) to create the universe of companies (and wells) and produce tabulations describing this universe. Based on this characterization of the universe a sampling plan will be developed. Selection of the sample of companies (and wells) will use Westat's proprietary software for sample selection, WESSAMP. A summary of this is included in the appendix. WESSAMP has been used for hundreds of U.S. government studies.

### **3.2 Element B.10: Questionnaire Data Management**

Most of the data used under this task will be maintained in SAS data files to allow for ease of analysis. Variables will be given English labels and values to assure that data are used correctly. Westat senior staff will review documents prepared by junior staff to assure proper documentation and use of data.

All memoranda will be tracked and numbered as called for in Westat's Current Best Method for documentation. This will assure version control and clarify what is replaced when/if it is needed. A summary of the documentation CBM is in the appendix to this QAPP.

Whenever possible we will use either COTS or well-documented Westat proprietary software that has been used on hundreds of government databases. An example is software developed to weight survey responses (WESWGT) that produces standard output to check for outliers, collapsing for nonresponse, and other key factors that must be reviewed to improve the final weights. By using such software Westat minimizes the opportunities for errors and simultaneously expedites the processing time required to produce final data sets.

Some of the data used by Westat under this task will be TSCA CBI, for example some of the responses from the questionnaires. All such data will be managed following the procedures set forth in EPA's TSCA CBI Protection Manual dated October 20, 2003 (3). Westat staff requiring access to TSCA CBI for this project will maintain active TSCA CBI clearance. The Westat Rockville office has an approved TSCA CBI storage area and multiple TSCA-compliant stand-alone computers, which allows Westat staff to work on TSCA CBI at that location.

## **4. Assessment and Oversight Elements**

This section describes technical review, audits, and corrective actions that will be performed on the hydraulic fracturing information evaluation to ensure the QAPP is implemented as approved.

### **4.1 Element C.1: Assessments and Response Actions**

All work conducted for the hydraulic fracturing project will be subject to technical review by Westat senior staff. Senior staff will approve planned work of more junior staff in advance so that there will be few surprises at the review stage. All deliverables will be reviewed by the Westat WAM before delivery to EPA.

David Morganstein will serve as the Westat QA Officer for this project. As part of Westat's QA/QC procedures on this project he will review this QAPP for completeness and applicability. He will be available to assist staff with QA issues as they arise and will periodically review compliance with the QAPP. He will discuss the findings of such reviews with the Westat Project Director.

Westat will cooperate with EPA on all assessments performed by EPA on the hydraulic fracturing project. EPA plans to conduct technical system assessments (TSAs), audits of data quality (ADQs), and QA review of final products.

### **4.2 Element C.2: Reports to Management**

Westat will describe QA activities conducted for major deliverables, such as summary memoranda, when such documents are delivered to EPA. These descriptions may be included in the document or in the transmittal email, as directed by EPA. Additionally, Westat will provide the EPA WAM with monthly reports on the status of QA activities. These reports will be incorporated into Westat's monthly technical progress reports, and will include descriptions of any problems encountered and identification of problem resolution and/or corrective actions taken during the reporting period.

## **5. Data Validation and Usability Element**

This section describes data review, verification, and validation. It also discusses how validated data will be evaluated to determine if they adequately answer the questions posed in Section 2.2.2 and meet the quality objectives stated in Section 2.4.

### **5.1 Elements D.1 and D.2: Data Review, Verification, and Validation; and Validation Methods**

Westat will review all of the data that may be used for completeness and representativeness. We will examine whether the data covers the entire country and specifically if it includes all of the major shale plays. While there is no known total number of wells drilled, we will compare estimates from the multiple data sources to determine if there are obvious gaps in some of these sources.

Westat will review all data sets for apparent outlier values. We will attempt to determine whether these are indeed true values, the result of data entry errors, or have some other explanation. We will discuss these outliers with EPA and those who provided the data in an attempt to determine how best to utilize these special cases. The changes made to data based on these reviews will be documented in our final report.

### **5.2 Element D.3: Reconciliation with User Requirements**

In Section 2.4 we described the checks Westat will use to determine the accuracy, timeliness, completeness, representativeness, and comparability of the data. Westat will report these measures of quality to the EPA WAM in the monthly report.

In addition, Westat will describe data quality and limitations in its reports so later data users may determine if the data are of sufficient quality for their use. Westat will work with EPA to determine to what extent data that do not meet the specified data acceptance criteria may be used to support EPA's Study on Hydraulic Fracturing and how this determination will be documented. All data use determinations will be made by EPA and data determined by EPA to be unacceptable will not be used to support this study.



Westat will include an evaluation of data quality in all project deliverables. Westat will also identify the sources of data, assumptions made, changes or modifications to data based on follow up conversations with industry representatives, and calculations used in their development in all project deliverables including databases. These identifications will be sufficiently detailed and transparent to ensure the reproducibility of the work by qualified third parties.

## 6. References

1. U.S. Environmental Protection Agency. EPA Requirements for Quality Assurance Project Plans QA/R-5. EPA/240/B-01/003. Office of Environmental Information, March 2001.
2. U.S. EPA 2010. U.S. Environmental Protection Agency, Science in Action, “Hydraulic Fracturing Research Study,” U.S. Office of Research and Development. [www.epa.gov/ord](http://www.epa.gov/ord), June 2010.
3. U.S. Environmental Protection Agency, TSCA CBI Protection Manual, EPA Office of Pollution Prevention and Toxics (7407 M), October 20, 2003.

## **Appendix A**

### **CURRENT BEST METHOD FOR DOCUMENTATION**

This appendix is Westat Confidential Business Information and should not be shared by EPA with any other organization without permission from Westat

**Appendix A and Appendix B were marked CBI and were therefore removed from this version of the document.**